cyclonic disturbance central in the Ohio and Mississippi watersheds. The storm area was particularly well marked on November 8, 1897, as it moved from Illinois to the St. Lawrence Valley, and the system of south and west winds on its southeastern side extended as far as the southern stations in Florida, excepting only Key West. Above these lower winds were the cold westerly upper currents. The region of numerous thunderstorms attending this area of low pressure extended from Illinois to Massachusetts and southward to Tennessee, as shown by the figures above given. Occasional sporadic thunderstorms were reported on the 7th, 8th, and 9th, as follows: Arkansas, 0, 1, 0; Kansas, 2, 1, 0; Louisiana, 0, 2, 1; Kentucky, 0, 2, 0; Maine, 0, 0, 2; Maryland, 0, 0, 2; Michigan, 0, 2, 0; Mississippi, 0, 1, 0; Nebraska, 2, 0, 0; New Hampshire, 0, 1, 1; Rhode Island, 0, 0, 1; Texas, 0, 1, 0; West Virginia, 0, 0, 1. There is, therefore, no reason to doubt but that the disturbed electrical condition extended southeastward from the storm center into Florida, although of course the intensity of the disturbance in that region may have been exceedingly feeble. The temperature at Key West ranged between 65° and 75°, and one would, therefore probably have to ascend 10,000 feet before coming to a temperature of 32°. Between Key West and the storm center the whole country was covered with warm southerly winds, and the height of the isotherm of 32° may have been even more than 10,000 feet. In this region the disturbed electrical condition was relieved by the lightning flashes of the numerous thunderstorms. The air that was not thus suddenly brought to electric equilibrium could, by retaining some of its electric charge, eventually give rise to an aurora when its free electricity was being silently dissipated in gentle streams from the points of snow crystals and their elementary spiculæ.

MOONSHINE AND FROST.

Referring to an article under the above caption in the MONTHLY WEATHER REVIEW for March, 1898, Dr. J. W. Kales, M. D., Franklinville, N. Y., says:

The idea conveyed in that article is that frosts occurring before full moon are not injurious to vegetation, while frosts occurring after the full moon may be injurious.

During the night of May 12–13, 1895, a frost occurred in this section of New York State. It completely destroyed the grass crop and all growing crops; even killed the leaves on the trees, and in some places killed the trees. The leaves turned as brown as in October, and the meadows were as bare of grass as in September. In a word, it destroyed every kind of vegetation. The effects of this frost are still felt throughout this section. The full moon occurred on the evening of the 18th of May, 1895.

These facts are not in accord with this moon theory. Hence, like the other moon theories, this one is all "moonshine."

WATERSPOUTS.

The following extracts from newspapers refer to some special features of waterspouts which it is desirable to put on record.

From the Daily Globe, of June 21, Pensacola, Fla., we take the following:

On Monday, June 20, in the morning, a spout formed on the west side of Pensacola Bay, near Black Hammock, in the shape of a little whirl, and started across the bay in a straight line, gathering force and volume as it went, until it struck on the east bank, near the mouth of East Bay, where upon a sudden it seemed to make connection with an immense black funnel-shaped cloud, forming a complete tube to the water, which it sucked up in immense quantities. The rotary motion of the cloud or spout twisted off the tops of the pines, and they could be seen going up the spout as through an immense glass tube, the water and tree tops rushing up with fearful velocity, when of a sudden it [the spout] seemed to lift from the water, and, with a swiftly rolling motion, gradually drew up into the cloud, whither it gradually spread and disappeared over the expanse of sky.

Those who witnessed this immense waterspout state that it was the largest and most perfect one ever seen in these waters.

From the Press, July 19, Cleveland, Ohio, we take the following:

A remarkable cloud formation appeared in the northwest sky over the lake late in the afternoon of Monday, July 18. It was large and black and boiled and whirled in an angry manner. The shape was that of a cone lying on its side instead of point down like a tornado cloud. Above and beneath the threatening inky cloud the bright sun shone. Shortly after the cloud's first appearance the sky became fully overcast and a heavy rainfall ensued. The whirling motion possessed by the cloud was almost at right angles to that of a waterspout, since in the latter the point of the cone extends nearly straight downward.

PERIODIC FLUCTUATIONS OF THE GREAT LAKES.

Mr. F. Napier Denison, of the Meteorological Service of Canada, and who has just been assigned to duty in British Columbia in order to build up a forecast system for that region, has lately published in the Canadian Engineer a paper on the "Great Lakes as a Sensitive Barometer." Mr. Denison seems to have begun the detailed study of the subject in 1896, and at once proceeded to construct a self-recording gauge showing the fluctuations of Lake Ontario at the mouth of the Humber River, 3 miles west of Toronto, on quite a large scale as to time and amplitude, viz, 1 inch of paper for an hour of time and a quarter of an inch of paper to an inch of fluctuation of the water level. A second self-recording apparatus was subsequently set up in September, 1896, at the Burlington Canal, at the southwest extremity of Lake Ontario, about 40 miles from Toronto. The records given by Mr. Denison's instrument are on a somewhat larger scale than those of the ordinary tide gauge, and in its latest construction Mr. Denison has added another record equivalent to that of a water barometer. Thus, on the same recording sheet we have the records of atmospheric pressure, and, therefore, the ability to make a minute comparison between this and the lake level.

1. Mr. Denison finds that when the lake record is least disturbed, so also is the barometric trace.

2. When the lake undulations become large and rapid so do the oscillations of the atmospheric pressure.

3. The larger undulations in the lake have a period that averages twenty minutes, and the smaller ones average ten minutes.

4. The lake level is never stationary, but the smallest movement recorded for twelve consecutive hours was from one-half to one inch when the pressure trace was also very quiet.

5. Mr. Denison further concludes that the longitudinal and transverse seiches in Lake Ontario are due to great differences of atmospheric pressure between the extremities of the lake, which differences are doubtless augmented when the gale strikes the surface of the water. The longitudinal seiche has a period of four hours and forty-nine minutes, but the transverse seiches only forty-five minutes. When the isobars, as shown on the daily weather maps, lie parallel with the axis of the lake, the seiche movement becomes almost imperceptible. These seiches appear shortly before the passage of some severe storm and for several days thereafter.

6. The rapid heaping up of the water at the upper end of the lake, which is due to great differences of pressure in conjunction with the action of the wind, sets up powerful currents at the top and bottom of the lake, and after this disturbance of water level is over the seiche or oscillation of the whole lake begins.

7. In connection with Helmholtz's paper on atmospheric billows Mr. Denison suggests that the smaller undulations are due to the direct action of the atmospheric waves or billows as they move over the surface of the lake.

8. That these undulations in the lake level become rapid and of great amplitude during fine weather and rising or

stationary barometer, when an important area of high pressure is central over the Southern States.

9. That "the tidal waves," falsely so called, especially for Lake Erie, are due to large and rapid changes in atmospheric pressure such as are noticeable upon the barograph preceding or during thunderstorm conditions.

10. That the larger lake undulations may account for the existence of the greater waves encountered by fishermen and often termed the "three sisters."

The author adds that similar results to these for the lakes have been obtained by him from the study of the tidal records at St. John, N. B., and Halifax, N. S., and he is quite enthusiastic as to the useful results that may be attained in weather forecasting when such tidal records on the lakes and on the western seaboard are submitted to careful study.

Mr. Denison had the kindness to bring to the Weather Bureau samples of his interesting and valuable records, but after some consideration of the subject the Editor was forced to the conclusion that his large scale barograph curve will of itself be more useful in the study of and prediction of the weather than the record of the lake levels, which latter is full of fluctuations due to seiches and shorter waves and has no very close relation to the barograph or to the curve of air pressure. The study of the seiche is an important matter in the study of lake levels and engineering projects, but does not seem to be especially essential to meteorology.

HISTORIC DROUGHTS IN THE UNITED STATES.

From two well-known volumes (Peirce, "On the Weather," Philadelphia, 1847, page 272, and Perley, "Historic Storms," Salem, 1891, pages 58 and 66) we learn something about two of the severest droughts on record. The meteorologist will find it an interesting problem to explain, even in a general way, the reasons for these great departures from normal conditions.

1749. The spring was uncommonly dry, and by the end of May pastures were all scorched and burned in eastern Massachusetts. The drought probably continued longer and was felt more severely than any one that the people had before experienced. June 9 was appointed as a day of public fasting and prayer. Between July 1 and 6 plenty of showers fell in New England, and the period of drought was brought to an end. A small crop of hay, barley, and oats and a good crop of indian corn were harvested; flax and herbs of all kinds were a failure; cattle were killed in the autumn to save the great expense of keeping them through the winter.

1762. There was scarcely any rain from April 9 to August 18, and in some places, as at Danvers, until September 22. The month of April was cold. There was a slight drizzling rain at Boston May 7 and June 3 and showers on June 18. July 7 a fast was held at Falmouth, Me., and at Milton, Mass. July 28, being fearful that a famine would ensue, a public fast was proclaimed in a number of cities. Refreshing showers occurred near Falmouth, but not elsewhere until August 18, when bounteous rain descended throughout New England. Crops were, of course, very light and cattle were generally slaughtered because of the difficulty of keeping them through the winter.

1816. This summer, which is known as the cold one, was also a very dry one in many regions. In Vermont no rain fell during May and very little in Connecticut. During June intense heats were followed by freezing weather, with snow squalls in several of the New England States. The snowfall on the 8th of June in Vermont amounted in some places to 12 and 18 inches. In July there was abundant rain in northwestern Massachusetts and New Hampshire; from that time a drought continued until October 22, having prevailed for one hundred and twenty days in Vermont. Owing to the cold and the drought the crops were an almost complete failure.

Our scanty records make it quite impossible to present a really satisfactory summary of the meteorological conditions that prevailed during these historic droughts, but it is sufficiently evident that any locality between Pennsylvania and Maine may count upon having an absolute drought of three months' duration at least once in a century and injurious droughts of a month's duration very much more frequently. It is by no means impossible for the farmer to secure admirable crops during such droughty seasons if he will make proper provision for artificial irrigation. It is much more business-like to profit by past experience and provide artesian wells, windmill water pumps, protected reservoirs, and irrigating ditches than to neglect all these and spend one's time in praying for rain. Fast days and prayers were all right for the early settlers of the country, before they knew the exact nature of our climate, but now that three hundred years of records have accumulated and we know or ought to know how to succeed in the struggle against the inexorable laws of nature, it behooves us to profit by our experience. New England farmers have been very slow to realize the profit that is to be drawn from a parched soil and a cloudless sunny sky by the simple means of irrigation. Methods of cultivation that have made the desert spots of central Asia, Algeria, northern India, Australia, and California profitable gardens have until lately been ignored in New England.

INTERNATIONAL BALLOON ASCENSIONS, JUNE 8, 1898.

The fifth series of international simultaneous balloon ascensions came off on the morning of June 8, with great success. The following brief summary is condensed from the full account that is published in Ciel et Terre, July 1, Vol. XIX, p. 203.

Owing to the interest in the subject, stimulated by the conference at Strasburg (see MONTHLY WEATHER REVIEW, November, 1896, pp. 365, 415, and 462, and April, 1898, p. 158), six nations, Austria, Belgium, Italy, France, Germany, and Russia took part in this most important meteorological campaign. The Daily Weather Map for Europe shows that on the morning of June 8 the isobar of 765 mm. covered central Europe with a very irregular curve, and that a pressure as low as 760 could only be found by going far to the west and south. Consequently, the most gentle barometric gradients prevailed throughout the region represented by the balloon ascensions, and very slight changes in pressure and temperature occurred during the twenty-four hours. Light rains had fallen on the immediate coast of the North Sea during the night before, and were again repeated during the following night, but the interior of the country was everywhere clear or partly cloudy, with rare cases of local thunderstorms. The morning temperatures ranged from 12° to 16°, the maximum temperatures 16° to 25° C., over this part of Europe. The operations at each station were as follows:

Vienna.—One sounding balloon and three ordinary military balloons, manned by officers of the army, were sent up successively at 6, 7, 8 a. m., and the last one at noon. The latter reached an altitude of 4,500 meters, where the temperature was —8° C.

Berlin.—Four balloons started, respectively, at 6 a. m., 9 a. m., and noon, and the last at 2 a. m. the next morning. Of course the winds near the ground were light and baffling, but the balloons moved slowly toward either west-northwest or west-southwest, according to their altitudes.

Paris.—The sky was so foggy in the morning that the sounding balloon could not be observed at the theodolite sta-